Check List the journal of biodiversity data
NOTES ON GEOGRAPHIC DISTRIBUTION

First record of *Camponotus textor* Forel, 1899 (Hymenoptera, Formicidae) from Ecuador

Ignacio J. Moreno-Buitrón[1], Selene Escobar-Ramírez[1], Isabel Becdach-Mesia[2], Diego F. Cisneros-Heredia[1, 3]

1 *Universidad San Francisco de Quito USFQ, Colegio de Ciencias Biológicas y Ambientales, Instituto de Biodiversidad Tropical IBIOTROP, Laboratorio de Zoología Terrestre, Museo de Zoología, Quito 170901, Ecuador*
2 *Università di Bologna, Department of Biological, Geological, and Environmental Sciences, Bologna, Italy*
3 *Instituto Nacional de Biodiversidad INABIO, Quito, Ecuador*

Corresponding authors: *Ignacio J. Moreno-Buitrón (ignaciomorenob99@gmail.com); Diego F. Cisneros-Heredia (diego.cisnerosheredia@gmail.com)*

Abstract. We present the first records of *Camponotus textor* Forel, 1899 (Hymenoptera, Formicidae) from Ecuador, representing the first records from west of the Andes. We explore the use of participatory science data from iNaturalist and scientific collections to understand the distribution of *C. textor*. While iNaturalist data alone cannot confirm the presence of *C. textor* due to the need for precise morphometric data, it can be a valuable tool for assessing the species' potential distribution. This study increases Ecuador's known ant species to 826 and *Camponotus* species to at least 61. Challenges in distinguishing *C. textor* and *C. senex* prevent us from determining *C. textor*'s native status and highlight the need for further research on *Camponotus* in Ecuador.

Key words. Camponotini, distribution, Formicinae, insect, Pacific lowlands, new records, weaver ant

Moreno-Buitrón IJ, Escobar-Ramírez S, Becdach-Mesia I, Cisneros-Heredia DF (2024) First record of *Camponotus textor* Forel, 1899 (Hymenoptera, Formicidae) from Ecuador. Check List 20 (3): 577–585. https://doi.org/10.15560/20.3.577

INTRODUCTION

Ants are a group of eusocial insects accounting for more than 14,000 described extant species worldwide (Kass et al. 2022; Bolton 2024). More than 4,000 species and subspecies of ants are recorded in the Neotropics, and research efforts in the last decades have significantly advanced ant diversity characterisation in the region (Cardoso et al. 2010; Achury and Suarez 2017; Fernández et al. 2021; AntWeb 2024a). In Ecuador, recent studies have improved our understanding of the ant fauna, and currently 825 ant species and subspecies have been identified (Guénard et al. 2017; Pazmiño-Palomino and Troya 2022). However, further research is needed to enhance our understanding of regional and local biodiversity patterns and ecological processes of ant communities in this megadiverse country.

Camponotus Mayr, 1861 is the second largest ant genus, after *Pheidole* Westwood, 1839, with over 1,000 described species, further divided into 43 subgenera (Bolton 2024). Given the high morphological variability within *Camponotus,* a general taxonomic characterisation of this group poses challenges (Bolton 1973). *Camponotus* is distributed worldwide and comprises more than 450 species in the Neotropics (Fernández et al. 2021; AntWeb 2024a). Although the diversity of *Camponotus* in Ecuador has not been thoroughly revised, and the literature and specialised databases still have many inconsistencies, at least 60 species and five subspecies of *Camponotus* are known in mainland Ecuador (Salazar et al. 2015; Guénard et al. 2017; Pazmiño-Palomino and Troya 2022; AntWeb 2024b).

Camponotus textor Forel, 1899 is a weaver ant that inhabits across the Neotropics, with populations reported in Mexico, Honduras, Costa Rica, Panama, French Guiana, Brazil, and Bolivia (Longino 2006; Ramalho et al. 2017; Dáttilo et al. 2020; AntWeb 2023a). *Camponotus textor* was previously considered a subspecies of the cavity-dwelling *C. senex* (Smith, 1858), until Longino (2006) validated it as a separate species. Its recognition as a distinctive species is currently supported by morphological, behavioural, ecological, biochemical (cuticular hydrocarbons), and molecular traits (Longino 2006; Ramalho et al. 2016a; Fox et al. 2017).

Traditional biodiversity data sources, such as museums and field surveys, are invaluable. However, these sources alone often struggle to keep pace with the vastness and complexity of ant diversity, making participative science an invaluable tool for researchers (Lucky et al. 2014). Thanks to the digital revolution,

OPEN ACCESS

Academic editor: Filippo Di Giovanni
Received: 10 November 2023
Accepted: 5 April 2024
Published: 7 May 2024

Copyright © The authors. This is an open-access article distributed under terms of the Creative Commons Attribution License (Attribution 4.0 International – CC BY 4.0)

participative science now plays a crucial role in expanding our understanding of ant diversity by engaging a large number of people (Braschler 2009; Lucky et al. 2014; Sorvari 2022). This broad participation expands the geographical and temporal scope of biodiversity data collection efforts, providing data points that researchers may not otherwise have access, including the identification and monitoring of rare ants or the early detection of non-native species (Sheard et al. 2020; Báthori et al. 2022).

In this contribution, we present the first records of *C. textor* from Ecuador, based on specimens collected during fieldwork in the Pacific lowlands, and explore the potential of participative science in detecting this species.

METHODS

We conducted field expeditions to agricultural landscapes without remains of native forests nearby, and close to small human settlements in the Pacific lowlands of central Ecuador. Specimens were collected at two private farms: Hacienda La Chelita (HLC, −00.6170, −79.4689, 150 m elevation) and Hacienda Santa Teresa (HST, 00.5977, −079.3903, 170 m elevation), in Los Ríos province, Ecuador.

Access to HLC was through the main street of the town of Los Ángeles, on the Troncal de la Costa highway connecting the cities of Santo Domingo de los Colorados and Quevedo. HST is 9 km northeast of HLC, 3 km after the town of Patricia Pilar on the Troncal de la Costa highway. Both farms have small houses surrounded by maize, cocoa trees, and African oil palm plantations. Since the early 1960s, intensive agricultural activities have eliminated all native vegetation, including secondary forests and shrublands. The closest area with native vegetation is approximately 30 km E (Samama Mumbes Wildlife Refuge). Both sites have average temperatures ranging from 22 to 24 °C and over 2,400 mm of annual precipitation, with a wet season between December and May and a dry season between June and November (Caicedo-Camposano et al. 2016). Three surveys were carried out: 9 October 2022 (HLC), 19 February 2023 (HLC), and 20 May 2023 (HST). One hour of sampling effort was dedicated to each survey. These surveys were conducted under the authorisation for specimens collection no. MAAE-ARSFC-2022-2203, issued by the Ministry of Environment, Water and Ecological Transition of Ecuador.

A total of 13 worker specimens were collected manually using entomological forceps and deposited in tubes with 70% ethanol. All collected specimens were dry-mounted and deposited at the Museo de Zoología, Universidad San Francisco de Quito, Quito, Ecuador (**ZSFQ**). Specimens were identified based on morphological and morphometric features following the guidelines of Fernández (2003) for genus identification, Longino (2006) and Mackay (2019) for subgenus identification, and Fox et al. (2017) for species identification. Specimens were examined using an Olympus SZX16 stereomicroscope and photographed with an attached Olympus DP73 digital camera. Eye length was measured between the anterior and posterior eye borders using cellSens Dimension v. 1.16. Measurements were made using photographs of all 13 workers in lateral view.

Occurrence data for *C. textor* from the Neotropics were obtained from iNaturalist, a participative science online portal by the California Academy of Science and National Geographic. Data search and extraction for iNaturalist were conducted on 20 September 2023 using the search terms "*Camponotus textor*" in the "Search" filter. We validated the taxonomic identification of each observation uploaded to iNaturalist and compiled geographic data, individually confirming all localities following the protocols described by Cisneros-Heredia and Peñaherrera-Romero (2020), and Cisneros-Heredia et al. (2023). iNaturalist data used for this study are available here: https://doi.org/10.5281/zenodo.10869127

To create the map showing the distribution of *C. textor,* we downloaded all occurrences available in the Global Biodiversity Information Facility (GBIF), excluding data from iNaturalist. Data search and extraction from GBIF were conducted on 26 July 2023 using the search terms "*Camponotus textor*" in the "scientific name" filter. These GBIF occurrences correspond to validated, vouchered records from the California Academy of Sciences, The Internacional Barcode of Life Consortium, the European Nucleotide Archive EMBL-EBI, and the Instituto de Ecología INECOL of Mexico. GBIF data used for map creation are available here: https://doi.org/10.15468/dl.89w2yw

RESULTS

Camponotus textor Forel, 1899

New records. ECUADOR – Los Ríos • Los Ángeles, Hacienda La Chelita; −00.6170, −079.4689; 150 m alt.; 09.X.2022; J. Montalvo & I. J. Moreno-Buitrón; hand collected; 1 ♀, ZSFQ-i11759, dry preserved • same locality; 19.II.2023; J. Montalvo & I. J. Moreno-Buitrón; hand collected; 3 ♀, ZSFQ-i11747, dry preserved; 3 ♀, ZSFQ-i11748, dry preserved; 3 ♀, ZSFQ-i11749, dry preserved • Patricia Pilar, Hacienda Santa Teresa; −00.5977, −079.3903; 170 m alt.; 20.V.2023; J. Montalvo & I. J. Moreno-Buitrón; hand collected; 3 ♀, ZSFQ-i11755, dry preserved.

All collected specimens were workers (11 minor workers and two major workers). Ants were active

during the morning and afternoon hours. At night, ants were inactive, and instead, *Acromyrmex* leaf cutter ants were seen in the same trails and locations used by *C. textor* workers during the day at HLC. No foraging behaviours were observed at HLC, while at HST, several workers were seen drinking water in a small plastic container near the nest. Other ant species found in sympatry with *C. textor* at both localities include *Acromyrmex* spp., *Atta* spp., *Odontomachus* spp., *Tapinoma melanocephalum* (Fabricius, 1793), *Ectatomma* spp., *Crematogaster* spp., and *Paratrechina longicornis* (Latreille, 1802). A silk nest of *C. textor* was found on top of a palm tree (Arecaceae: *Bentickia* sp.) at HST on 20 May 2023. The nest was about 60 cm long and approximately 4 m from the ground, built in a single palm leaf. A separate, smaller part of the nest was found in a different leaf from the same palm tree, but it seemed to be abandoned, as no ants were seen there.

Identification. We identified these specimens as *Camponotus* based on the following characteristics: posterior margin of clypeus apart from antennal alveoli by a distance equal to or greater than the diameter of alveoli and closure of metapleural gland (Fernández 2003). Specimens were identified as members of the subgenus *Myrmobrachys* Forel, 1912 because all workers exhibited a box-like propodeum with a broad, subrectangular dorsal face and the presence of gastral pubescence, a common feature in most species of *Myrmobrachys* (Longino 2006; Mackay 2019). One key characteristic differentiating *C. textor* from *C. senex* is the presence of appressed dense yellow pubescence on the gaster, giving *C. textor* a yellowish-golden colouration (Figure 1) (Longino 2006). Workers of *C. textor* generally have more reddish legs than *C. senex* workers (Figure 1) (Fox et al. 2017). However, leg colour in *Camponotus* spp. can be variable (Longino 2006), so eye length is the most useful characteristic for differentiating *C. textor* and *C. senex* (Fox et al. 2017). Eye length in *C. textor* workers ranges from 0.44–0.51 mm, while in *C. senex* workers is 0.50–0.65 mm (Fox et al. 2017). All specimens examined for this study showed dense yellow pubescence on the gaster, reddish legs (Figure 1), and eye length 0.42–0.49 mm (0.45 ± 0.02 mm, $n = 13$). Additionally, while *C. senex* is a species with high worker polymorphism, *C. textor* exhibits low worker polymorphism, as major workers are only slightly larger than minor workers (Longino 2006). Two workers collected at HST are most likely major workers, as they are slightly larger than the other collected workers. Also, the nest of *C. textor* is diagnostic, being a weaver ant building silk nests attached to leaves hanging from trees (Figure 2) (Longino 2006; Santos et al. 2016; Ramalho et al. 2016a). In contrast, *C. senex* is an opportunistic cavity nester, building nests in dead branches and twigs scattered on leaf litter (Longino 2006; Ramalho et al. 2016a).

A total of 27 observations identified as *C. textor* were obtained from pictures in iNaturalist from the Neotropics, 10 of which were from Ecuador. These observations showed *Camponotus* (*Myrmobrachys*)

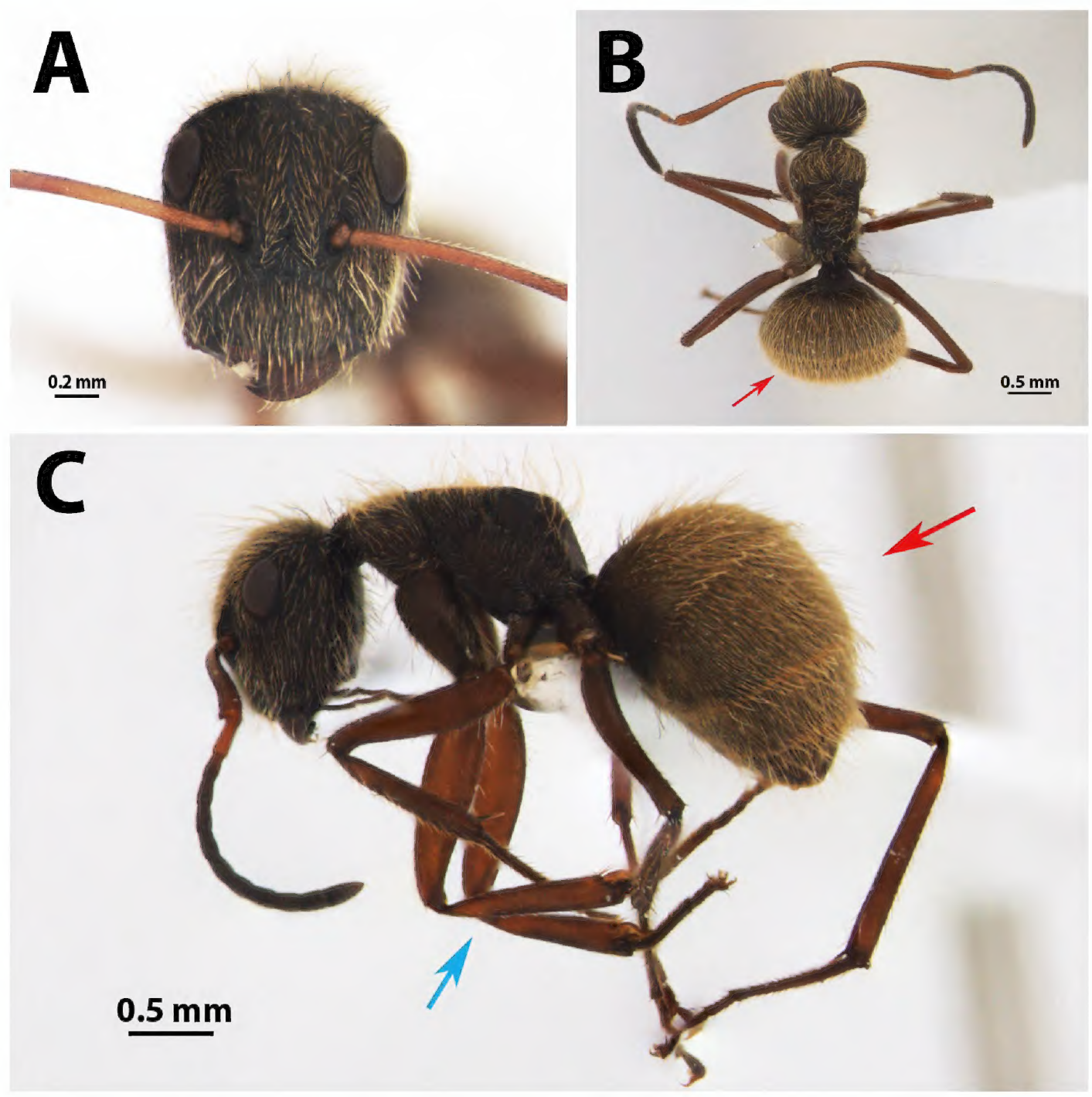

Figure 1. Worker of *Camponotus textor* (ZSFQ-i11747) collected at Hacienda La Chelita, province of Los Ríos, Ecuador. **A.** Head in frontal view. **B.** Dorsal view. **C.** Lateral view. Red arrows show the characteristic appressed dense yellow pubescence of this species. Blue arrow shows the distinct reddish legs of *C. textor*.

Figure 2. Different views of the nest of *Camponotus textor* at Hacienda Santa Teresa, Los Ríos, Ecuador.

ants with reddish legs and golden gaster. However, confirming the presence of *C. textor* based solely on photographs can be challenging. Eye length is the most reliable characteristic for distinguishing *C. textor* from *C. senex*, and it is not easy to measure in field-obtained photographs. We refrained from reporting the iNaturalist observations as confirmed records for *C. textor.* Nevertheless, iNaturalist observations suggest that the species occurrence in Ecuador is wider than can be inferred from our sampling in the Los Ríos province. Nine iNaturalist observations in Ecuador were from the Pacific lowlands, in the provinces of Los Ríos and El Oro, at elevations ranging from 10 to 490 m. One observation was from the inter-Andean valley in the Pichincha province at 2500 m. In addition to the Ecuadorian records, an observation of *C. textor* from Peru is also present in iNaturalist, from the Grapanazu sector, near Abra La Esperanza, Huancabamba district (iNaturalist 2022).

DISCUSSION

The records presented here are the first of *Camponotus textor* from Ecuador and the first west of the Andes, extending the geographic range of *C. textor* by approximately 1042 km from the nearest previously known locality (Platanilla, Panama; Figure 3) (AntWeb 2023b; GBIF.org 2023). *Camponotus textor* has been recorded in Central America (Honduras, Mexico, Costa Rica, and Panama; Longino 2006; Ramalho et al. 2017; Dáttilo et al. 2020) and South America (eastern Brazil, Bolivia, and French Guiana; Ramalho et al. 2017; AntWeb 2023a), making Panama the closest country to Ecuador in which *C. textor* is known (Figure 3). Given that *C. textor* was previously considered a subspecies of *C. senex* (Longino 2006; Ramalho et al. 2016a; Ramalho et al. 2016b), records of *C. senex* should be reviewed across its distribution to confirm its identification and avoid confusion with *C. textor*. *Camponotus senex* is considered a native species in several Central American countries and has also been reported in Venezuela, French Guiana, Guyana, Colombia, Peru, Ecuador, and Argentina (Escalante-Gutiérrez 1993; Fernández and Sendoya 2004; Longino 2006; Salazar et al. 2015; Franco et al. 2019). The paucity of information on the distribution of *C. textor*

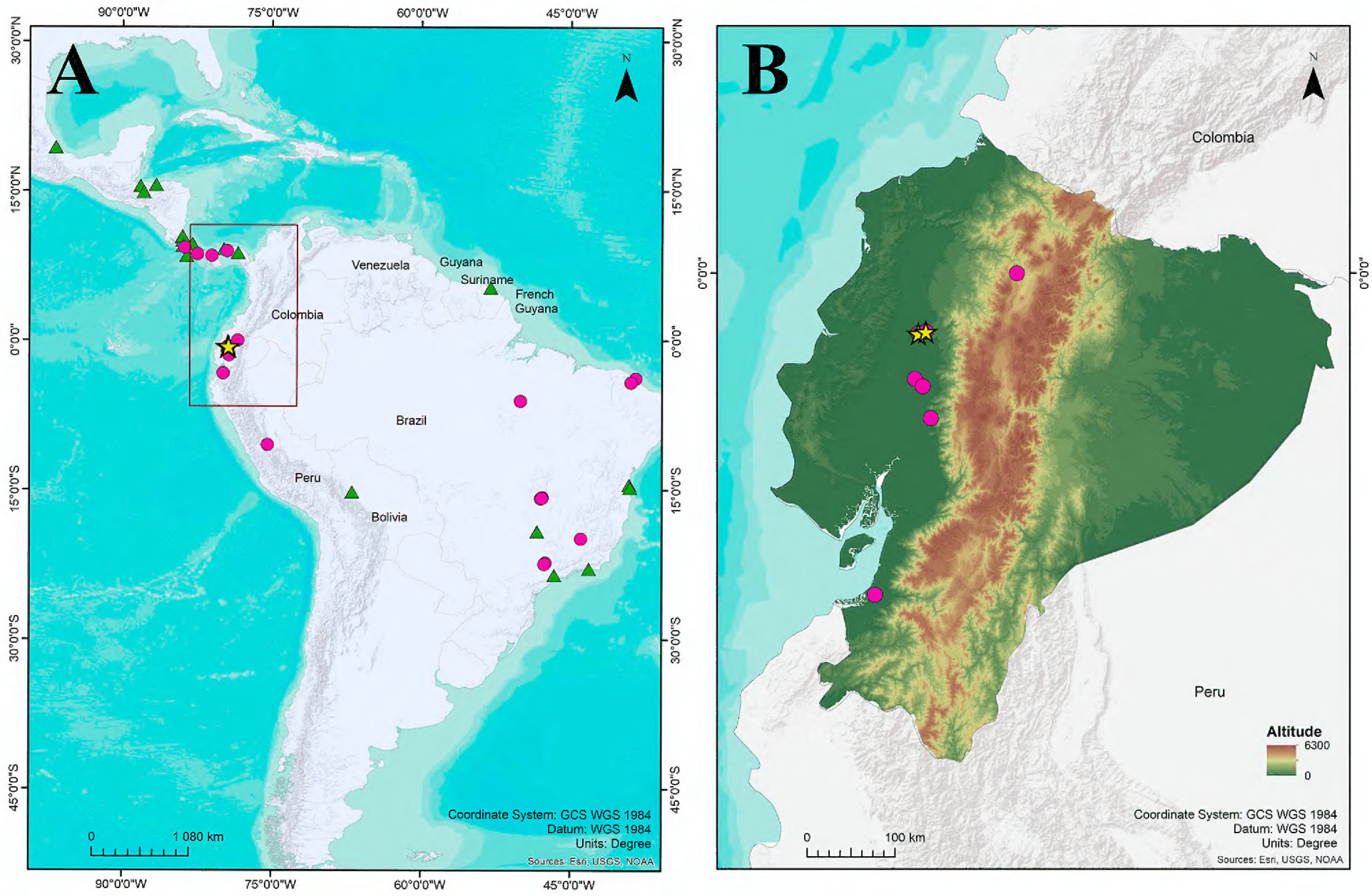

Figure 3. A. Map of Central and South America showing all known localities of *Camponotus textor*. **B.** Map of Ecuador showing the localities of *C. textor* in Ecuador. Yellow stars = New records of *C. textor* in Ecuador reported for this study; pink circles = iNaturalist observations reported as *C. textor*; green triangles = GBIF localities of *C. textor*.

and the possible confusion with older records reported as *C. senex* in northern South America prevent us from determining if *C. textor* is native to Ecuador (and previously confused with *C. senex*) or corresponds to a non-native species recently introduced in the country. This situation is further exacerbated by the few records and scientific collections of ants made in the Pacific lowlands of Ecuador (Salazar et al. 2015). Species richness and composition of ant communities from western Ecuador are still poorly known (Salazar et al. 2015; Pazmiño-Palomino and Troya 2022; Salazar-Basurto et al. 2023).

Although participatory science data plays a significant role in providing geographic data for ant species (e.g., Salazar-Basurto et al. 2023), it is essential that identification characters can be clearly discernible in photographic records uploaded on participatory science platforms. Since *C. textor* and *C. senex* are cryptic species (Longino 2006; Ramalho et al. 2016a; Fox et al. 2017), key morphological characteristics used to diagnose *C. textor* are best observed in photographs taken under stereomicroscopic magnification (Fox et al. 2017), thus making their identification using field-taken photographs challenging. However, participatory science records could be valuable for identifying potential new locations where *C. textor* could be found. Based on the data on iNaturalist for the provinces of El Oro and Pichincha, we recommend a survey to uncover the species of *Camponotus* present here.

Even though Longino (2006) reported that *C. textor* inhabits mature forest canopy, all our records come from agricultural lands, suggesting that *C. textor* may adapt to disturbed landscapes. Santos et al. (2016) reported that *C. textor* can build its nests on 24 plant species belonging to 14 families, some of them being economically important plants, such as mango and citrus trees. Our record of a nest of *C. textor* on an introduced cultivated palm *Bentinckia* sp. adds another host plant for this weaver ant.

Taxonomic changes, like the separation of cryptic taxa previously considered as the same species, make it difficult to provide a precise number for species of *Camponotus* in Ecuador, as there are several inconsistencies across different lists and online databases. For example, *Camponotus apicalis* is not reported by Salazar et al. 2015, but is considered a valid species for Ecuador in Fernández and Sendoya (2004), Guénard et al. (2017) and AntWeb (2024b). This discrepancy is due to its taxonomic status, since *C. apicalis* is considered a senior synonym of *Camponotus wheeleri* (Fernández 2002; AntWeb 2023c). Fernández (2002) reported *C. apicalis* as a senior synonym of *C. wheeleri*, Fernández and Sendoya (2004) reported *C. apicalis* but not *C. wheeleri*, Salazar et al. (2015) reported *C. wheeleri* but not *C. apicalis*, and the databases GABI (Global Ant Biodiversity Informatics) (Guénard et al. 2017) and AntWeb (2024b) reported both

C. apicalis and *C. wheeleri* for Ecuador. We suggest that further efforts should focus on a comprehensive revision of the genus *Camponotus* in Ecuador.

Our study highlights the importance of combining scientific collections and participatory science data to provide helpful information for identifying cryptic species. Although it is not possible to certainly identify observations from iNaturalist as *C. textor*, participative data can still be used as a first approach for assessing the potential distribution of this species in territories where they have not been previously reported (Báthori et al. 2022). While analyses based on morphological, ecological, behavioural, and molecular data are important to understand better the evolutionary relationships and taxonomy of *Camponotus textor*, participative data based on non-expert observations can aid in documenting this and other rare or poorly studied taxa. Further research on *Camponotus* ants in Ecuador should focus on their ecology. The ecological roles of *C. textor* need to be assessed to understand its impacts on agricultural ecosystems. Some carpenter ants have been reported as structural pests destroying wooden frameworks and electrical installations (e.g., *Camponotus pennsylvanicus* (De Geer, 1773) (Bueno and Campos-Farinha 1999); ecological facilitators of agricultural pests due to their aggressive behaviour safeguarding Homoptera (e.g., *Camponotus rufipes* (Fabricius, 1775) and *Camponotus brasiliensis* Mayr, 1862, Fowler 1991); or pest of honeybee colonies (e.g., *Camponotus floridanus* (Buckley, 1866), Akre and Hansen 1990). Carpenter ants may also be potential biocontrol agents in agricultural systems, with *Camponotus senex* demonstrating high efficiency in removing herbivores in mango trees (Santos et al. 2016) and reducing pests in shaded coffee (Philpott et al. 2004, 2005). Further analysis and research could provide insight into the role of *C. textor* both as a potential pest and a biological pest control agent in agricultural systems.

ACKNOWLEDGEMENTS

We are grateful to the owners of Hacienda La Chelita and Hacienda Santa Teresa for their hospitality and for granting us complete access to their properties for carrying out this research project, especially Jaime Andrade, Emma Andrade, Hilda Andrade, Walter Andrade, Nancy Andrade, María Fernanda Andrade, and Manuel León. We thank the staff of the Laboratory of Terrestrial Zoology, Institute of Tropical Biodiversity IBIOTROP, Universidad San Francisco de Quito USFQ (Ecuador) for their assistance during our use of its high magnification stereomicroscopy equipment and museum facilities, and the support offered by Margarita López-García, Emilia Peñaherrera, and Jorge Montalvo at the Museum of Zoology of Universidad San Francisco de Quito. Nelson Miranda, professor at USFQ and curator of the Herbarium of Economic Botany of Ecuador, helped us identify the host palm where the nest of *C. textor* was found. We thank Emilia Peñaherrera and Naia Andrade for their help with the map.

ADDITIONAL INFORMATION

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

This study was authorised by the Ministry of Environment, Water and Ecological Transition of Ecuador (no. MAAE-ARSFC-2022-2203)

Funding

This study was financially supported by Universidad San Francisco de Quito USFQ, through research, outreach and operative funds assigned to the Institute of Tropical Biodiversity IBIOTROP, and a publication grant awarded to Diego F. Cisneros-Heredia by the office of the Dean of Research.

Author contributions

Conceptualization: IJMB, SER, DFCH. Data curation: IJMB. Formal analysis: IJMB, DFCH. Funding acquisition: DFCH. Investigation: IJMB, DFCH. Methodology: IJMB, DFCH. Resources: IJMB, DFCH. Supervision: SER, DFCH. Visualization: IJMB. Project administration: IJMB. Validation: IJMB, SER, DFCH. Writing – original draft: IJMB, SER, IBM, DFCH. Writing – review and editing: IJMB, SER, IBM, DFCH.

Author ORCID iDs

Ignacio J. Moreno-Buitrón https://orcid.org/0009-0003-1067-7760
Selene Escobar-Ramírez https://orcid.org/0000-0002-1603-4710
Isabel Becdach-Mesia https://orcid.org/0009-0004-4626-501X
Diego F. Cisneros-Heredia https://orcid.org/0000-0002-6132-2738

Data availability

All data supporting this study's findings are available in the main text and the following depositories: https://doi.org/10.5281/zenodo.10869127 and https://doi.org/10.15468/dl.89w2yw.

REFERENCES

Achury R, Suarez AV (2017) Richness and composition of ground-dwelling ants in tropical rainforest and surrounding landscapes in the Colombian Inter-Andean Valley. Neotropical Entomology 47 (6): 731–741. https://doi.org/10.1007/s13744-017-0565-4

Akre RD, Hansen LD (1990) Management of carpenter ants. In: Meer RKV, Jaffe K, Cedeno A (Eds.) Applied myrmecology—a world perspective. Westview Press, San Francisco, USA, 693–700.

AntWeb (2023a) Species: *Camponotus* (*Myrmobrachys*) *textor* Forel, 1899. California Academy of Science. https://www.antweb.org/description.do?genus=camponotus&species=textor&rank=species&countryName=Panama. Accessed on: 2023-07-19.

AntWeb (2023b) Specimen: CASENT0882305. California Academy of Science. https://www.antweb.org/specimenImages.do?name=casent0882305. Accessed on: 2023-11-01.

AntWeb (2023c) Species: *Camponotus* (*Dendromyrmex*) *apicalis* (Mann, 1916). California Academy of Science. https://www.antweb.org/description.do?subfamily=formicinae&genus=camponotus&species=apicalis&rank=species&countryName=Ecuador. Accessed on: 2023-11-07.

AntWeb (2024a) Bioregion: Neotropical. California Academy of Science. https://www.antweb.org/bioregion.do?name=Neotropical. Accessed on: 2024-03-18.

AntWeb (2024b) Country: Ecuador. California Academy of Science. https://www.antweb.org/taxonomicPage.do?rank=species&countryName=Ecuador. Accessed on: 2023-11-07.

Báthori F, Jégh T, Csősz S (2022) Formerly considered rare, the ant species *Cryptopone ochracea* (Mayr, 1855) can be commonly detected using citizen-science tools. Biodiversity Data Journal 10: e83117. https://doi.org/10.3897/bdj.10.e83117

Bolton B (1973) The ant genera of West Africa: a synonymic synopsis with keys (Hymenoptera: Formicidae). Bulletin of the British Museum (Natural History) Entomology 27: 317–368. https://doi.org/10.5281/zenodo.26841

Bolton B (2024) An online catalog of the ants of the world. AntCat. https://antcat.org/catalog/429011?include_full_statistics=true. Accessed on: 2024-02-19.

Buckley SB (1866) Descriptions of new species of North American Formicidae. Proceedings of the Entomological Society of Philadelphia 6: 152–172.

Bueno OC, Campos-Farinha ADC (1999) Formigas urbanas: estratégias de controle. Vetores & Pragas 2 (5): 5–7.

Braschler B (2009) Successfully implementing a citizen-scientist approach to insect monitoring in a resource-poor country. BioScience 59 (2): 103–104. https://doi.org/10.1525/bio.2009.59.2.2

Caicedo-Camposano O, Cadena-Piedrahita D, Alcívar-Torres L, Veloz-Paredes A, Montecé-Mosquera F (2016) Análisis del comportamiento de las precipitaciones en Quevedo – Ecuador, para la planificación de cultivos. European Scientific Journal 12 (33): 212–220. https://doi.org/10.19044/esj.2016.v12n33p212

Cardoso DC, Sobrinho TG, Schoereder JH (2010) Ant community composition and its relationship with phytophysiognomies in a Brazilian Restinga. Insectes Sociaux 57 (3): 293–301. https://doi.org/10.1007/s00040-010-0084-3

Cisneros-Heredia DF, Peñaherrera-Romero E (2020) Invasion history of *Harmonia axyridis* (Pallas, 1773) (Coleoptera: Coccinellidae) in Ecuador. PeerJ 8: e10461. https://doi.org/10.7717/peerj.10461

Cisneros-Heredia DF, Izurieta M, Peñaherrera E, Musschenga M (2023) Range expansion and breeding of White-Cheeked Pintail (*Anas bahamensis*) in the High Andes. Waterbirds 45 (2): 218–244. https://doi.org/10.1675/063.045.0213

Dáttilo W, Vásquez-Bolaños M, Ahuatzin DA, Antoniazzi RP, Chávez-González E, Corro EJ, Luna PPG, Guevara R, Villalobos F, Madrigal-Chavero R, De Faria Falcão JC, Bonilla-Ramirez AJ, Romero AÁ, De La Mora A, Ramírez-Hernández A, Escalante-Jiménez AL, Martínez-Falcón AP, Villarreal A, Sandoval AGC, Aponte B, Juárez-Juárez B, Castillo-Guevara C, Moreno CE, Albor C, Martínez-Tlapa DL, Huber-Sannwald E, Escobar F, Montiel-Reyes FJ, Varela-Hernández F, Castaño-Meneses G, Pérez-Lachaud G, Pérez-Toledo GR, Alcalá-Martínez I, Rivera-Salinas IS, Chairez-Hernández I, Chamorro-Florescano IA, Hernández-Flores J, Toledo JM, Lachaud JP, Reyes-Muñoz JL, Valenzuela-González JE, Horta-Vega JV, Cruz-Labana JD, Reynoso-Campos JJ, Navarrete-Heredia JL, Rodríguez-Garza JA, Pérez-Domínguez JF, Benítez-Malvido J, Ennis KK, Sáenz L, Díaz-Montiel LA, Tarango-Arámbula LA, Quiroz-Robedo LN, Rosas-Mejía M, Villalvazo-Palacios M, Gómez-Lazaga M, Cuautle M, Aguilar-Méndez MJ, Baena ML, Madora-Astudillo M, Rocha-Ortega M, Pale M, García-Martínez MA, Soto-Cárdenas MA, Correa-Ramírez MM, Janda M, Rojas P, Torres-Ricario R, Jones RW, Coates R, Gómez-Acevedo SL, Ugalde-Lezama S, Philpott SM, Joaqui T, Marques T, Zamora-Gutierrez V, Mandujano VM, Hajian-Forooshani Z, MacGregor-Fors I (2020) Mexico ants: incidence and abundance along the Nearctic–Neotropical interface. Ecology 101 (4): e02944. https://doi.org/10.1002/ecy.2944

De Geer C (1773) Mémoires pour servir à l'histoire des insectes. Tome troisième. Stockholm: Pierre Hesselberg, 696 pp.

Donoso DA (2017) Tropical ant communities are in longterm equilibrium. Ecological Indicators 83: 515–523.

Escalante-Gutiérrez JÁ (1993) Especies de hormigas conocidas del Perú (Hymenoptera: Formicidae). Revista Peruana de Entolomogía 34 (1): 1–13.

Fabricius JC (1775) Systema entomologiae, sistens insectorum classes, ordines, genera, species adiectis synonymis, locis, descriptionibus, observationibus. Flensburgi et Lipsiae [= Flensburg and Leipzig]. Korte, 832 pp.

Fabricius JC (1793) Entomologia systematica emendata et aucta. Secundum classes, ordines, genera, species, adjectis synonimis, locis observationibus, descriptionibus. Tome 2. Hafniae [= Copenhagen]: C.G. Proft, 519 pp.

Fernández F (2002) Revisión de las hormigas *Camponotus* del subgénero *Dendromyrmex* (Hymenoptera: Formicidae). Papeis Avulsos de Zoologia (São Paulo) 42 (4): 47–101.

Fernández F (2003) Introducción a las hormigas de la región Neotropical. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Bogotá, Colombia, xxvi + 398 pp.

Fernández F, Sendoya S (2004) Lista sinonímica de las hormigas Neotropicales (Hymenoptera: Formicidae). Biota Colombiana 5 (1): 3–109.

Fernández F, Guerrero RJ, Sánchez-Restrepo AF (2021) Systematics and diversity of Neotropical ants. Revista Colombiana de Entomología 47 (1): e11082. https://doi.org/10.25100/socolen.v47i1.11082

Forel A (1899i) Formicidae. [concl.]. Biologia Centrali-Americana Hym 3: 137–160.

Forel A (1912) Formicides néotropiques. Part VI. 5me sous-famille Camponotinae Forel. Mémoires de la Société Entomologique de Belgique 20: 59–92.

Fowler HG (1991) Carpenter Ants (*Camponotus* spp.): pest status and human perception. 1st edition. In: Vander Meer RK, Jaffé K, Cedeño A. (Eds). Applied Myrmecology: a world perspective. Westview Press, San Francisco, USA, 525–532.

Fox EGP, Solis D, Lazoski C, Mackay WP (2017) Weaving through a cryptic species: comparing the Neotropical ants *Camponotus senex* and *Camponotus textor* (Hymenoptera: Formicidae). Micron 99: 56–66. https://doi.org/10.1016/j.micron.2017.03.016

Franco W, Ladino N, Delabie JHC, Dejean A, Orivel J, Fichaux M, Groc S, Leponce M, Feitosa RM (2019) First checklist of the ants (Hymenoptera: Formicidae) of French Guiana. Zootaxa 4674 (5): 509–543. https://doi.org/10.11646/zootaxa.4674.5.2

GBIF (2023) GBIF occurrence download, *Camponotus textor* Forel, 1899, Neotropics. https://doi.org/10.15468/dl.89w2yw. Accessed on: 2023-07-26.

Guénard B, Weiser MD, Gómez K, Narula N, Economo E (2017) The Global Ant Biodiversity Informatics (GABI) database: Synthesizing data on the geographic distribution of ant species (Hymenoptera: Formicidae). Myrmecological News 24: 83–89. https://doi.org/10.25849/myrmecol.news_024:083

iNaturalist (2022) *Camponotus textor*. iNaturalist. https://www.inaturalist.org/observations/145454330. Accessed on: 2023-10-20.

Kass JM, Guénard B, Dudley KL, Jenkins CN, Azuma F, Fisher BL, Parr CL, Gibb H, Longino JT, Ward PS, Chao A, Lubertazzi D, Weiser M, Jetz W, Guralnick R, Blatrix R, Lauriers JD, Donoso DA, Georgiadis C, Gomez K, Hawkes PG, Johnson RA, Lattke JE, Macgown JA, Mackay W, Robson S, Sanders NJ, Dunn RR, Economo EP (2022) The global distribution of known and undiscovered ant biodiversity. Science Advances 8 (31): eabp9908. https://doi.org/10.1126/sciadv.abp9908

Latreille PA (1802) Histoire naturelle des fourmis, et recueil de mémoires et d'observations sur les abeilles, les araignées, les faucheurs, et autres insectes. Impr. Crapelet (chez T. Barrois), Paris, France, xvi + 445 pp.

Longino JT (2006) New species and nomenclatural changes for the Costa Rican ant fauna (Hymenoptera: Formicidae). Myrmecologische Nachrichten 8: 131–143.

Lucky A, Savage AM, Nichols LM, Castracani C, Shell L, Grasso DA, Mori A, Dunn RR (2014) Ecologists, educators, and writers collaborate with the public to assess backyard diversity in The School of Ants Project. Ecosphere 5 (7): 1–23. https://doi.org/10.1890/es13-00364.1

Mackay WP (2019) New World carpenter ants of the hyperdiverse genus *Camponotus* (Hymenoptera: Formicidae). Volume 1: introduction, subgenera, species complexes, and subgenus *Camponotus*. Lambert Academic Publishing, London, UK, 420 pp.

Mayr G (1861) Die europäischen Formiciden. Nach der analytischen Methode bearbeitet. C. Gerolds Sohn, Vienna, Austria 80 pp.

Mayr G (1862) Myrmecologische Studien. Verhandlungen der Kaiserlich-Königlichen Zoologisch-Botanischen Gesellschaft in Wien 12: 649–776.

Pazmiño-Palomino A, Troya A (2022) Ants of Ecuador: new species records for a megadiverse country in South America. Revista Brasileira De Entomología 66 (2): 2–15. https://doi.org/10.1590/1806-9665-rbent-2021-0089

Philpott SM (2005) Trait-mediated effects of parasitic phorid flies (Diptera: Phoridae) on ant (Hymenoptera: Formicidae) competition and resource access in coffee agro-ecosystems. Environmental Entomology 34 (5): 1089–1094. https://doi.org/10.1093/ee/34.5.1089

Philpott SM, Maldonado JH, Vandermeer J, Perfecto I (2004) Taking trophic cascades up a level: behaviorally-modified effects of phorid flies on ants and ant prey in coffee agroecosystems. Oikos 105 (1): 141–147. https://doi.org/10.1111/j.0030-1299.2004.12889.x

Ramalho M, Santos R, Fernandes TT, Morini M, Bueno OC (2016a) Cytochrome c oxidase I DNA sequence of *Camponotus* ants with different nesting strategies is a tool for distinguishing between morphologically similar species. Genetica 144 (4): 375–383. https://doi.org/10.1007/s10709-016-9906-1

Ramalho MO, Martins CDL, Silva LO, Martins VG, Bueno OC (2016b) Molecular profile of the Brazilian Weaver Ant *Camponotus textor* Forel (Hymenoptera, Formicidae). Neotropical Entomology 45 (5): 463–470. https://doi.org/10.1007/s13744-016-0392-z

Ramalho MO, Martins CDL, Silva LO, Martins VG, Bueno OC (2017) Intracellular symbiotic bacteria of *Camponotus textor*, Forel (Hymenoptera, Formicidae). Current Microbiology 74 (5): 589–597. https://doi.org/10.1007/s00284-017-1201-6

Salazar-Basurto J, Troya A, Romero FJ, Wild AL, Pazmiño-Palomino A (2023) They arrived and don't stop coming: an update on the distribution of exotic ants (Hymenoptera, Formicidae) in continental Ecuador. Check List 19 (6): 801–819. https://doi.org/10.15560/19.6.801

Salazar F, Reyes-Bueno F, San-Martín D, Donoso DA (2015) Mapping continental Ecuadorian ant species. Sociobiology 62 (2): 132–162. https://doi.org/10.13102/sociobiology.v62i2.132-162

Santos JEP, Aguiar JJM, Alves T, De Almeida WR, Del-Claro K (2016) New records of host plants used by a weaver ants *Camponotus textor* Forel, 1899 (Hymenoptera: Formicidae). Journal of Environmental Analysis and Progress 1 (1): 111–116. https://doi.org/10.24221/jeap.1.1.2016.966.111-116

Sheard JK, Sanders NJ, Gundlach C, Schär S, Larsen RS (2020) Monitoring the influx of new species through citizen science: the first introduced ant in Denmark. PeerJ 8: e8850. https://doi.org/10.7717/peerj.8850

Smith F (1858) Catalogue of hymenopterous insects in the collection of the British Museum. Part VI. Formicidae. British Museum, London, UK, 216 pp.

Sorvari J (2022) Biogeography and habitat preferences of red wood ants of the *Formica rufa* group (Hymenoptera: Formicidae) in Finland, based on citizen science data. European Journal of Entomology 119: 92–98. https://doi.org/10.14411/eje.2022.010

Westwood JO (1839) An introduction to the modern classification of insects; founded on the natural habits and corresponding organisation of the different families. Volume 2. Part XI. Longman, Orme, Brown, Green and Longmans, London, UK, 193–224.